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The Brunkeberg System™ for installing Lindner unitized facades

Henrik Falk, Mathias Farnebo, Ludwig Schmid



In issue 4. 2010, IGS, IGS reported about a revolutionary installation innovation: new techniques for safer, faster, wind independent construction: The Brunkeberg System™ for installing Lindner unitized Facades. The key benefits have been defined as:

- Reduced time and costs for installation
- Easy handling and high quality of prefabricated unitized façade
- Unique re-cladding system

It's time now to have a look at what has happened since December 2010! But first who is Brunkeberg? who is Lindner? what is this revolutionary system?

Brunkeberg: An innovation company from Sweden, has introduced a new system for unitized curtain wall installation, inspired by lean production principles developed by the car manufacturing industry.

Lindner: The Company undertakes major worldwide projects in all areas of interior finishes, insulation technology, industrial services and building facades. From pre-planning through to project completion. The Company's extensive manufacturing capability enables quality to be strictly maintained whilst allowing maximum flexibility to meet



The Brunkeberg System™ for installing Lindner unitized facades, a revolutionary concept for installation and demolition of existing facades

individual project requirements. Environmental considerations are fundamental to all Lindner's business principles. Through partnerships with clients Lindner turns concepts into reality.

This Swedish innovation, combined with Lindner's experience will achieve radical reduction of the overall installation time required and of the risks of damage and delays, whilst providing a safer method for handling prefabricated façade panels on site.

"For projects involving unitized curtain walls with highly modular design, we see the potential for a 40% reduction of the programme time" says Mathias Farnebo of Brunkeberg Industriutveckling.

The Brunkeberg System™ was developed and tested in cooperation with Brunkeberg Industriutveckling AB of Sweden, and is now available for projects where speed and safety of installation are of particular importance.

History

It all started with the Swedish inventor Henrik Falk radically re-thinking the handling of glass. He noticed the difficulties in using large elements of glass and recognised the untapped potential. To his mind, the entire chain of events was in need of re-engineering in order to avoid

the time wasting and risky multiple handling he had observed. With determination and a strong desire to simplify how glazed panels are manufactured and handled. Henrik and his partner Mathias Farnebo embarked on an entrepreneurial journey to validate these ideas with help from various professional disciplines through feasibility studies, rigorous patent research and business evaluation. Once the core concept was structurally resolved and patented, the next step was to analyse and fine-tune the logistic benefits.

Brunkeberg contacted Arup in 2009, asking for a review of the concept. Arup quickly realised that this might just be what was needed to improve the speed and safety of curtain wall installation. To bring in more practical façade experience with curtain walling, challenging projects, design, manufacturing, logistics and installation - Lindner Façade was contacted, and agreed to develop mock ups for tests and further investigation.

In June 2010, Brunkeberg successfully completed functionality tests on a full-scale prototype built by the Lindner Group in Germany, this project as mentioned, was reported in December 2010 in IGS.

The need to reduce CO2 emissions from

buildings is increasing the demand for replacement of older, energy leaking curtain wall facades, yet this is often easier said than done. Not only due to high investment costs but also practicalities prevent building owners from tackling this task. Often the whole building has to be evacuated for several months or even years, because the installation of scaffolding and the creation of isolated internal transport routes is considered too much of a disturbance for existing tenants. This means a loss of rental income for the building owner. On other projects, the re-cladding works progress slower and at higher cost because working hours and transportation routes need to be carefully adapted to fit in with the tenants' business operation.

What is new

To avoid these problems, Brunkeberg and Lindner have developed the next generation façade system with components for façade replacement. A second and much bigger prototype with lots of technical improvements was built and can be visited and tested in Arnstorf, Bavaria, where Lindner Façade's headquarter is based, as well as production, research and development departments and a full size test rig. In July 2012 an official test was successfully completed. This rigorous test was independently conducted by IFT Rosenheim.

Summary of test results

Airtightness:

up to 600 Pa which is class A4 according EN 15152.

Watertightness:

up to 600 Pa which is class R7 according EN 12154.

Resistance to wind load:

1550 Pa serviceability and 2325 Pa safety for wind pressure
2030 Pa serviceability and 3045 Pa safety for wind suction

The system

Conventionally, unitized curtain wall elements are delivered to site by truck, off loaded and stored on pallets or stillages, then transported to the respective floors where they are stored until they can be installed using glazing robots or monorails systems. For large panels, the tower crane is used for lifting and installation, which is unfortunately a fairly slow process. All current methods are affected by wind and rain, which often interrupt progress and lead to frustrating pile-ups of materials and delivery vehicles queuing whilst waiting for their turn to have access to the crane for off-loading.

The Brunkeberg System combines standard unitized curtain wall panels with a vertical rail system that becomes an integral part of the final assembled wall. The vertical rails are integrated in the mullions, becoming effectively wind posts of sufficient structural strength to take the loads from very large panels. They further accommodate a temporary horizontal conveyor system which connects directly to the vertically stacked panels as they arrive on the delivery truck. The panels are easily moved along the horizontal conveyor and then lifted vertically by Brunkeberg's own mini crane directly into their final position.

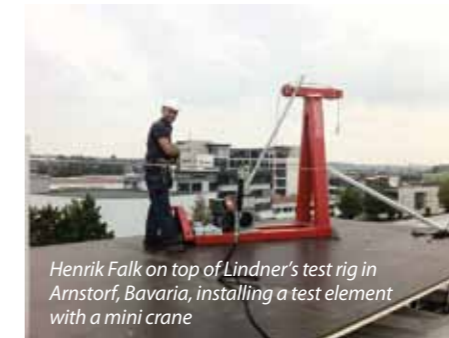
The system is suitable for both new construction and re-cladding projects

Reduced time and costs for installation

- Highly efficient logistics with option for remote off-loading
- Faster installation with a minimum of staff on site
- No interim storage or unnecessary handling
- Installation unaffected by weather conditions



Official test done by IFT Rosenheim, at Lindner's test rig in Arnstorf



Henrik Falk on top of Lindner's test rig in Arnstorf, Bavaria, installing a test element with a mini crane



A façade element is fixed in the lifting profile and moved upwards



A façade element is placed on the brackets automatically, and is driven by its own weight



Façade system advantages

- Large and small prefabricated elements can be easily handled
- Permanent vertical rails to secure cleaning & maintenance equipment, shading and façade lighting
- Enhanced safety for installation personnel

Unique recladding system

- Wind safe access system
- Minimal disturbance to occupants

Combining the best features

Lindner designs, manufactures and installs a wide range of standard and bespoke unitized façade systems. This new façade concept combines Lindner's high performance façade systems with a unique engineered installation system to achieve a fully controlled site installation process. It integrates the necessary infrastructure to guide each element securely into position with precision. Elements are installed without interim handling or storage – they are delivered on specially adapted pallets and directly transferred to the installation rails. The system allows even the largest elements to be installed safely and efficiently.

At low or ground level, a horizontal conveyor for the lateral distribution of the panels is temporarily fitted, providing safe and rapid

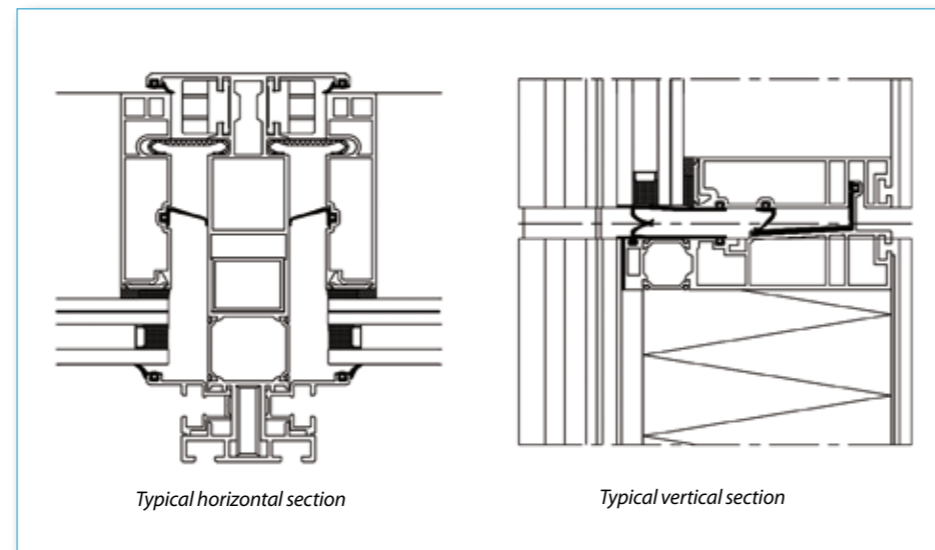
transport without additional handling equipment. These features make the Brunkeberg System™ largely independent from weather conditions, other trades and facilities on site, allowing an uninterrupted flow of the installation process.

Multi-functional profiles

The vertical multi-functional profiles feature external channels that enable the secure restraint of unitized façade elements throughout the lifting and positioning process.

After completion of the installation, these channels provide the option to act as a guide profile for maintenance access platforms, cradles and a semi-automated façade cleaning system. At roof level, a permanent conveyor can be integrated to provide lateral transfer for any cleaning or access equipment.

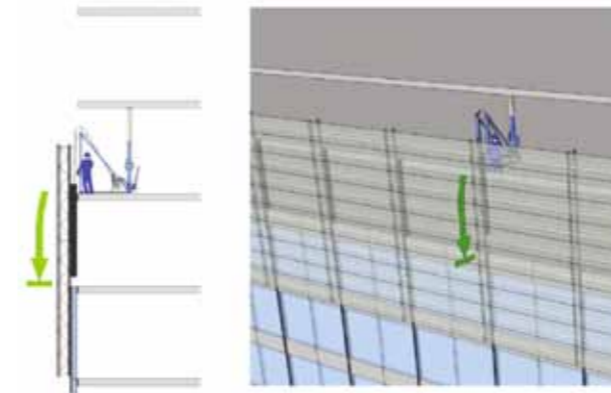
This built-in infrastructure enables the installation of solar shading, lighting or vertical fins and signage without penetrating any of the vapor barriers and airtight layers.



Typical horizontal section

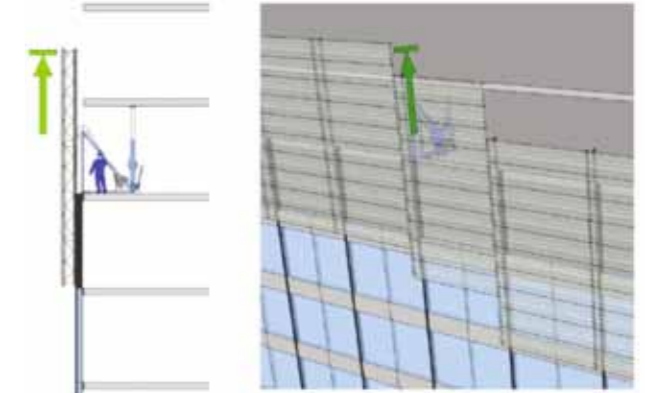
Typical vertical section

Installation sequence for new buildings



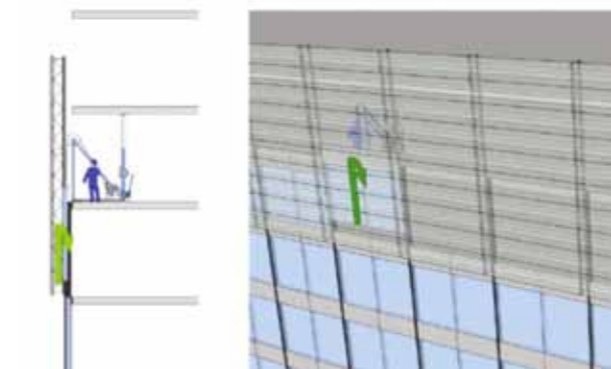
Install multi-functional profile (wind post)

Special fixing brackets, accommodating all structural loads and tolerances, are installed to the floor slab edge. Floor high multi-functional profiles are then fitted from the floor slabs and supported from the top.



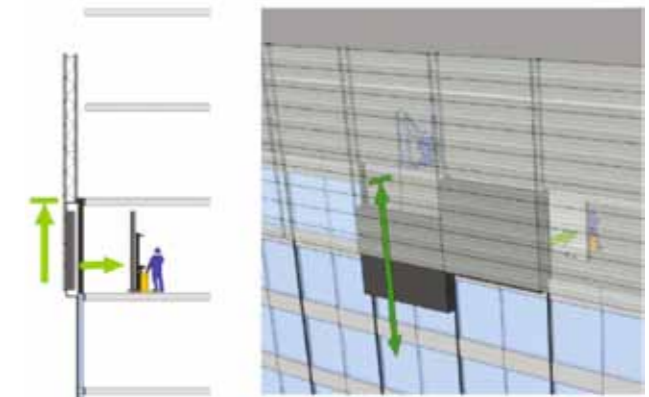
Lift mounting tool

The mounting tools are secured on to the vertical rails of the multi-functional profiles. They are lightweight and easily lifted by the mini-crane. Alternatively the mounting tool can be integrated in the wind post.



Install cladding panel

The element is lifted by the mini-crane while being securely guided within the rails of the multi-functional profiles at all times. They are lifted slightly higher than the level of their final position and then pushed inwards to align with the plane of the finished façade. At floor level, the mounting tool pushes the element into final position. The panel is secured in final position with sliding in glazing beads.



Transport Container

Containers for interior fit-out supplies and tools can also take advantage of the speed and safety of the transport system.



The system for re-cladding

The Brunkeberg System™ also offers a unique replacement system for glazed curtain walls, with tools for safe dismantling and the removal of debris. The re-cladding is executed from the ground floor upwards. Typically the occupants only need to be exposed to the temporary protective wall at two floors at any one time. The system facilitates the installation of new elements as well as the transport of containers. These containers accommodate debris and panels from dismantling the old façade, or can be used for tools or any other components for interior refurbishment that need to be transported up or down.

The demolition of the existing façade can in this way be carried out without traditional scaffolding and external hoist, or needing to break down the components into parts small enough for transport through the interior using internal elevators. Safety and security risks are minimized, as well as the disturbance of building occupants caused by external scaffold.

Conforming to Highest Standards

Like all of Lindner's project solutions, this new façade concept has been engineered to the highest standards. The mullions and their interaction with the unitized panels in their final position are structurally optimized to minimize the structural depth of the façade elements and minimizes costs.

The complete system was extensively tested on a three story high external rig to rigorously

test functionality in a range of climatic conditions and subsequently to verify structural deflections, wind safety, acoustics air and water tightness.

Reduce the cost for maintenance

Cost efficiency during installation shouldn't be the end of considerations: the permanent guide rails enable the use of a semi-automated façade cleaning system that runs in these channels.

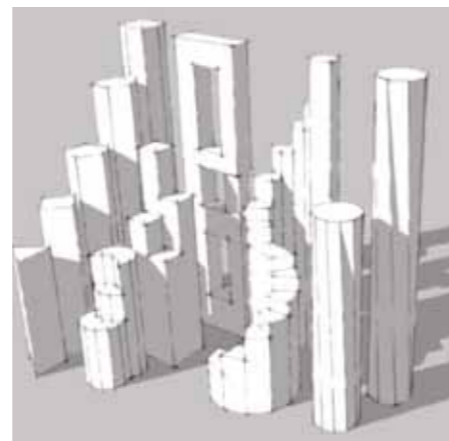
Future Proofing

The aim is to enable owners to upgrade the façade when the next generation technology is available. Using the multi-functional profiles available. Using the multi-functional profiles paves the way for replacing the façade design without increasing the costs or program for the initial installation.

External features like vertical fins or balconies can be integrated without creating cold bridges or complex interfaces. Panels up to six meter



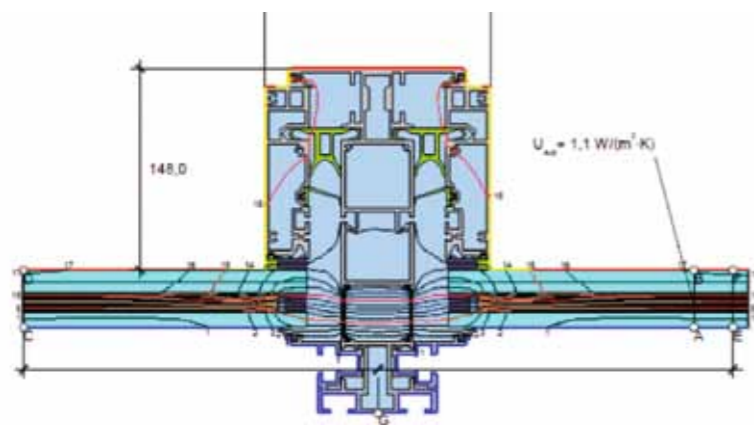
width can be designed with interim mullions and transoms or extraordinarily large panes of glass. Openings, glazed and solid infill panels are feasible.



Examples of geometries achievable with straight aligned mullions

The Brunkeberg System™ relies on parallel rails to achieve optimal efficiency. For further design combinations, the system can be combined with any other curtain wall or window system utilizing traditional access and maintenance solutions.

Thermal behaviour (with double glazed unit $U_g = 1,1 \text{ W/m}^2 \text{ K}$)



Temperature inside room 20 °C
 Temperature outside 0 °C
 Minimum Temperature on inner surface 14 °C